

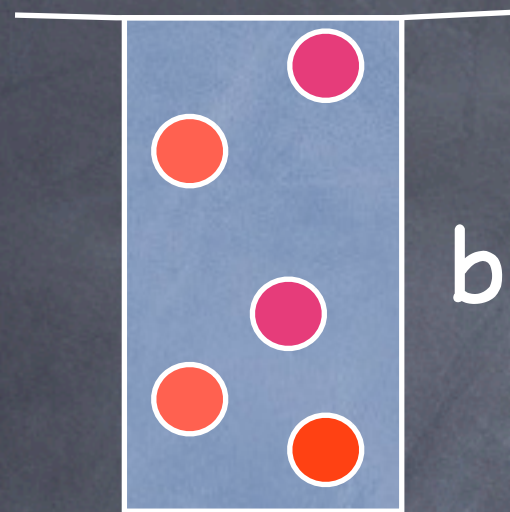
Chapter 2: Matter and Change

LAB 2.1: States of Matter

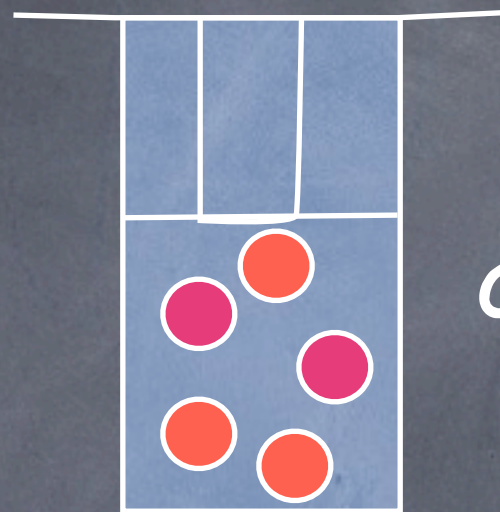
Objective:

Create a model for each of the 3 states of matter, using your powers of observation.

- Solid: form of matter with a definite shape and definite volume
- Liquid: form of matter with a definite volume but no definite shape– it will take the shape of a container
- Gas: a form of matter that has no definite shape and no definite volume
- What is the difference between a vapor and a gas? Why “water vapor” not “water gas”?
- Vapor: describes the gaseous state of a substance that is generally a liquid or a solid at room temperature

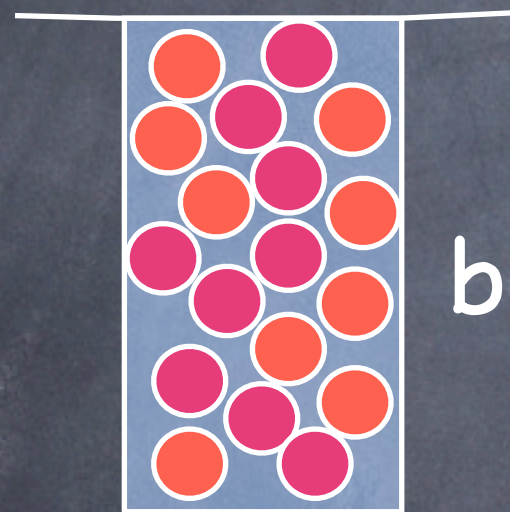


before

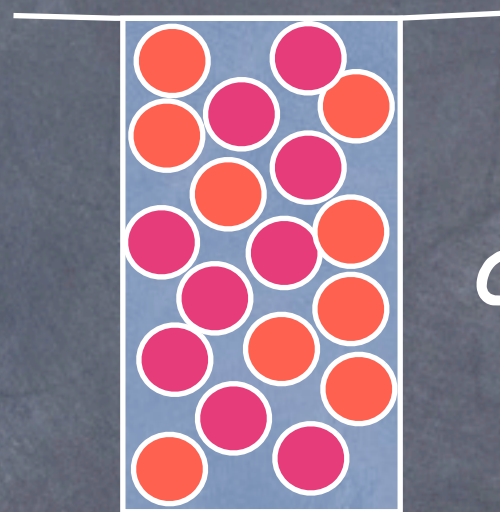


after

GAS

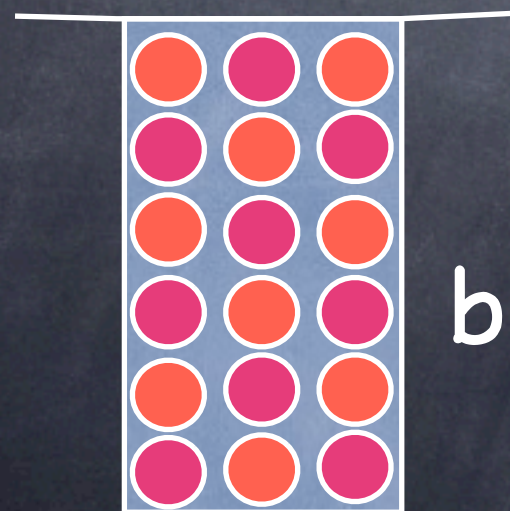


before

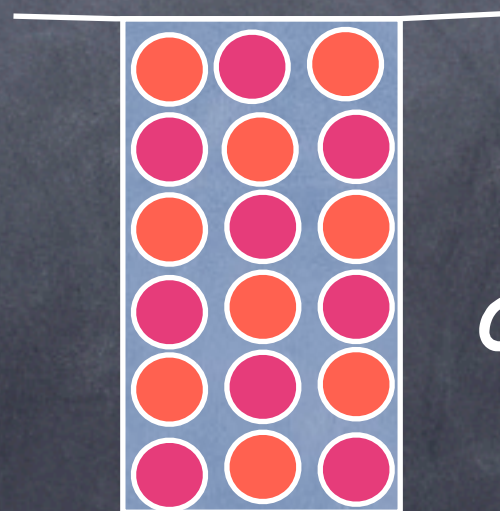


after

LIQUID





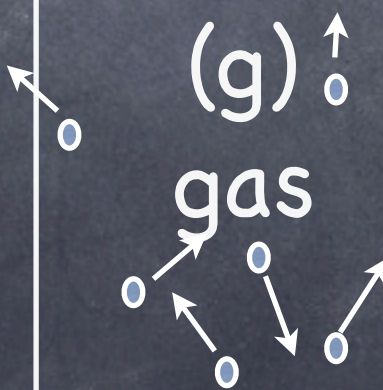
before



after

SOLID

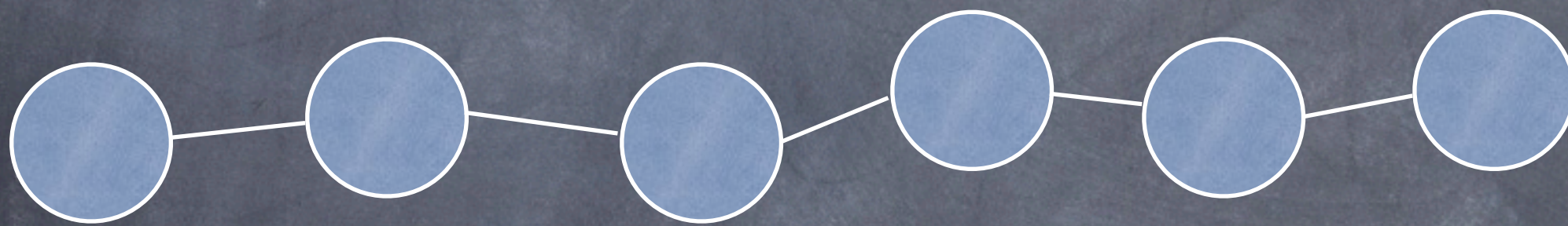
Use this
chart to
help
remember
these
extensive
properties

(s) solid 	definite shape	definite volume	almost incompressible
(l) liquid 	indef. shape	definite volume	almost incompressible
(g) gas 	indef. shape	indef. volume	easily compressible

What about Oobleck? Or the “unknown substance?”

Both of these substances are polymers.

What is a polymer?



– a substance consisting of a long chain of molecules

Lab 2.2: Chemical changes and the nature of matter

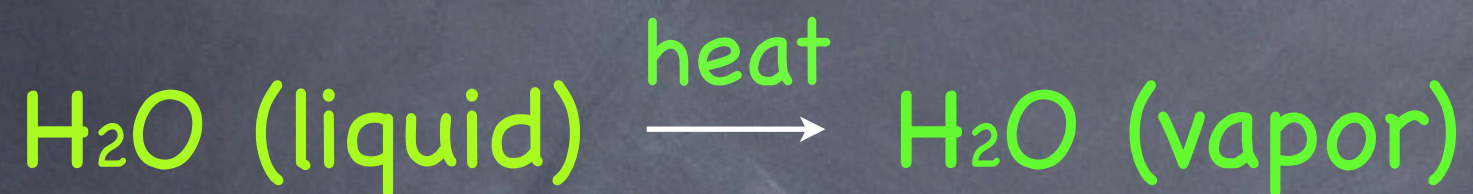
Objectives:

To identify when a chemical reaction takes place based on observations.

To record observations and interpretations using words and pictures.

To become familiar with how chemicals react.

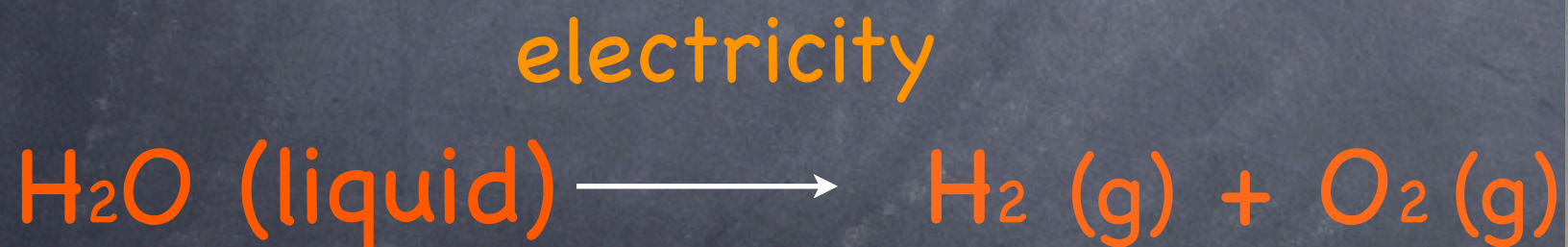
Physical vs. Chemical Changes



reactant is same as product

the only change is a change in the state of matter

...this is a PHYSICAL CHANGE



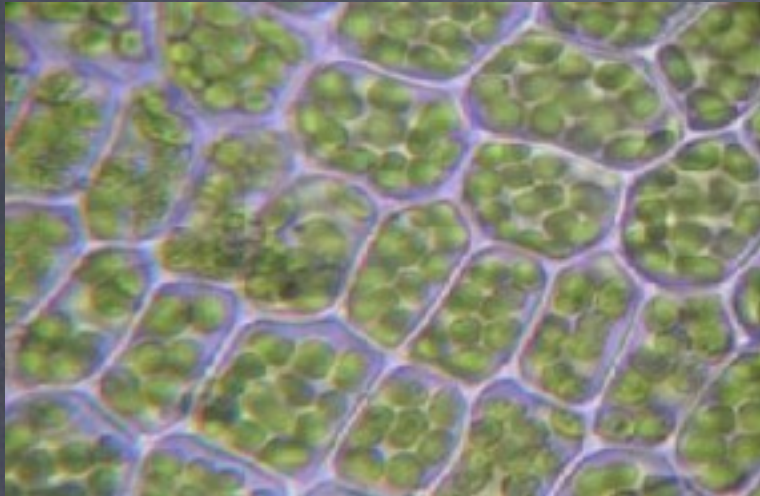
reactant and products are not the same

...this is a CHEMICAL CHANGE

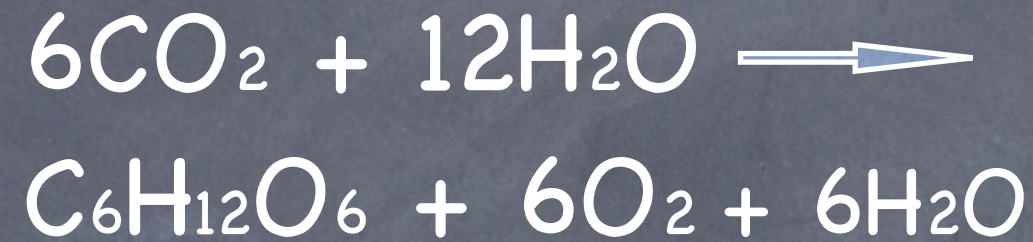


Electrolysis of Water

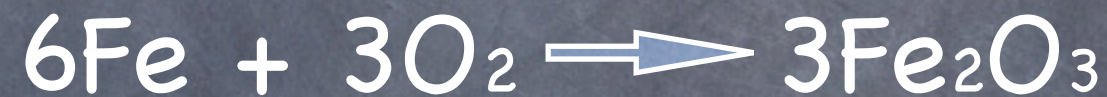
Examples of common chemical changes



Photosynthesis

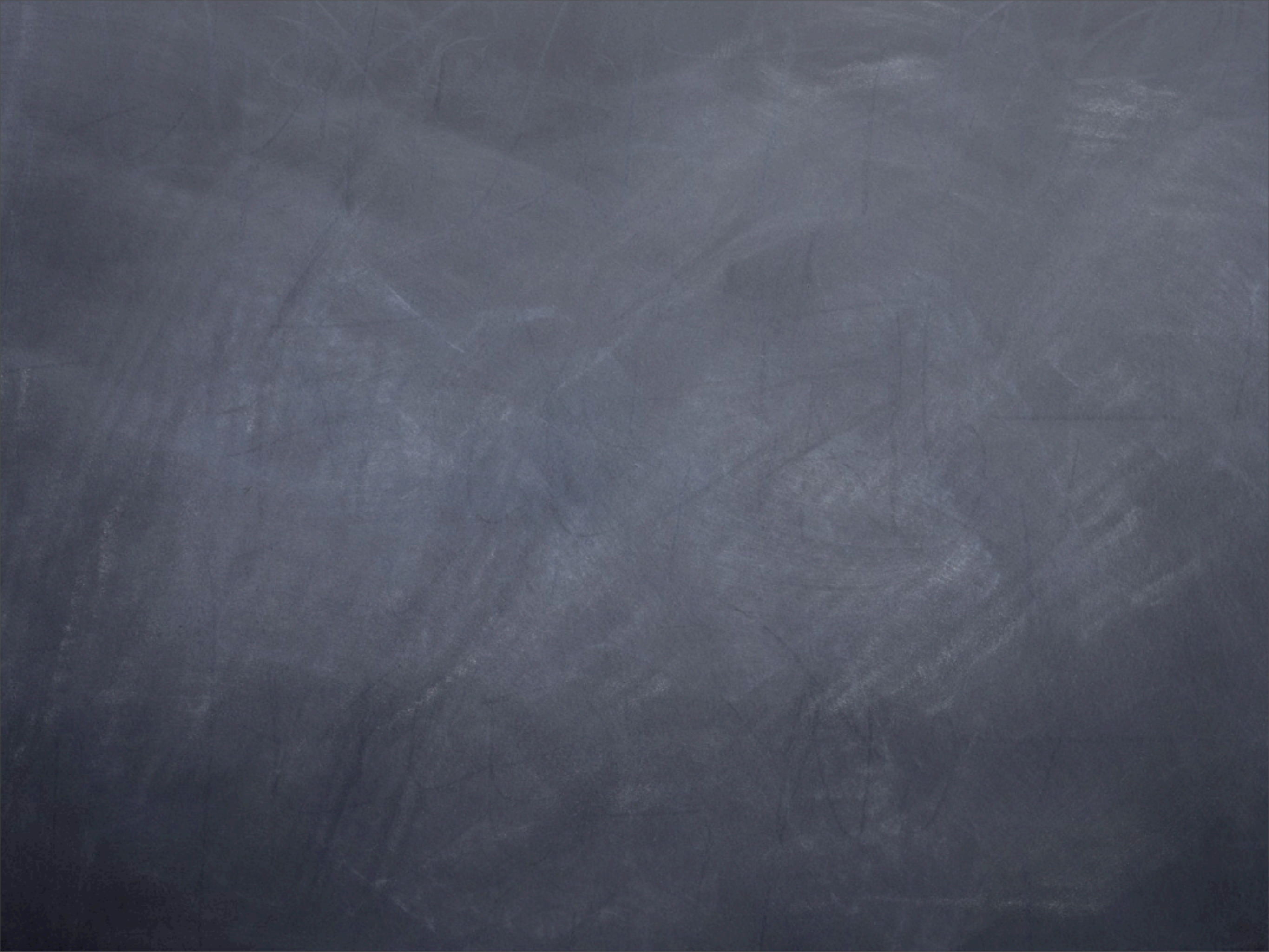


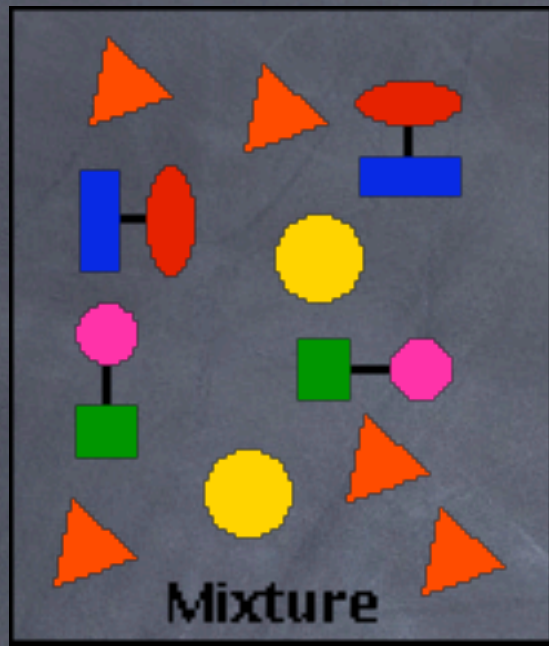
Oxidation (Rusting)



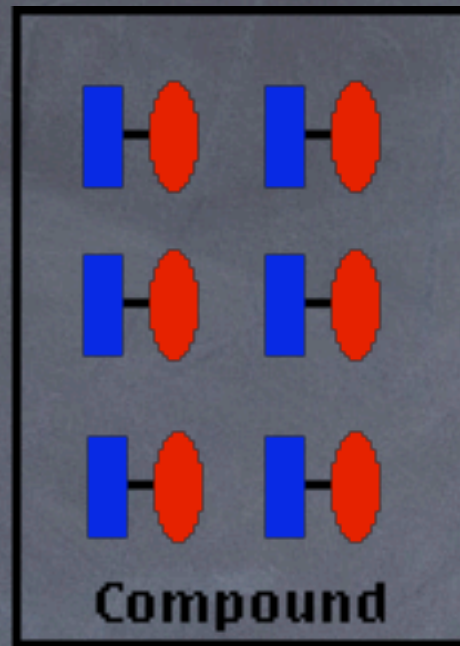
Combustion (Burning)



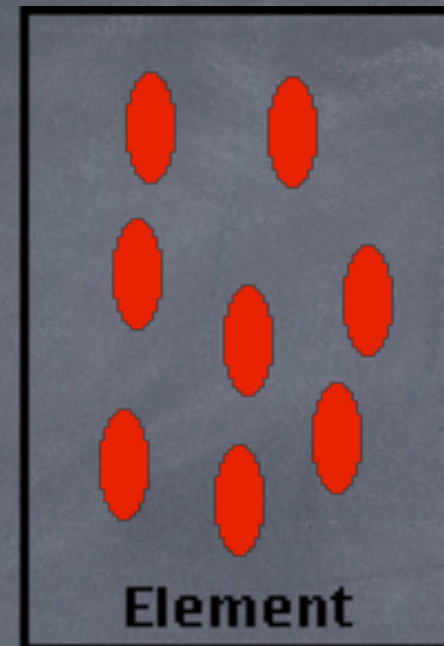
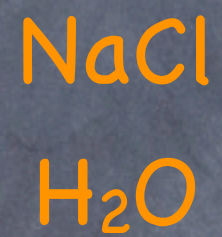




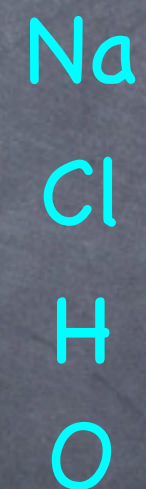
Mixture



Compound



Element



• CLASSIFYING MIXTURES:

- mixture: a physical blend of two or more components
- There are two types of mixtures...
heterogeneous and homogeneous mixtures
- Hetero: not uniform composition
- Homo: uniform composition
homogeneous mixtures are also called
solutions

- Solutions can be solid, liquid, or gas! What is a solid solution?

- Phase: a term used to describe any part of a sample that has uniform composition and properties

- Example:

OIL	VINEGAR	OIL & VINEGAR
-----	---------	---------------

Homo	Homo	Hetero
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1 phase	1 phase	2 phases
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- How many more days until winter break??
JUST KIDDING!!!

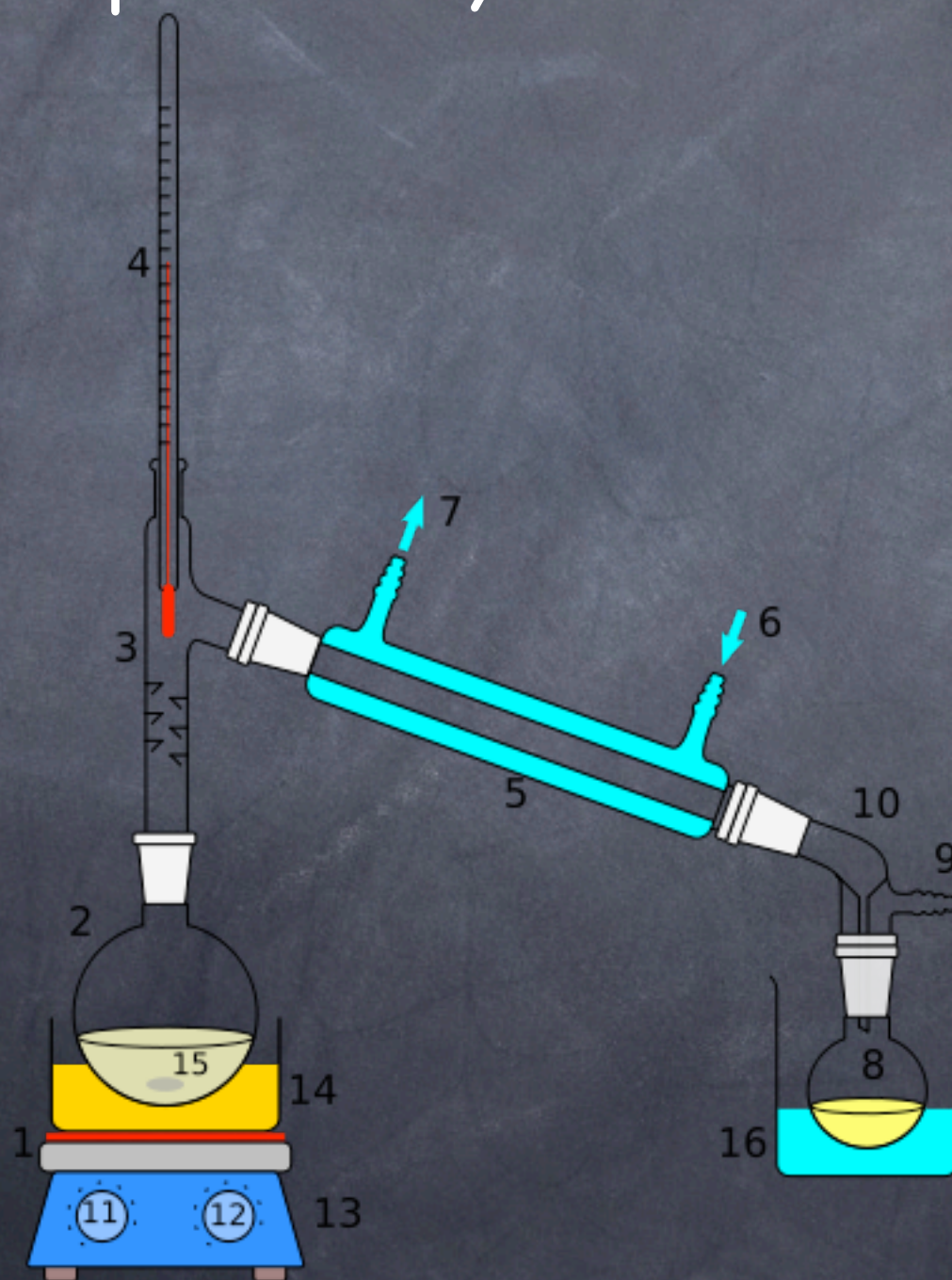
- Separating Mixtures
- **Filtration:** used to separate by size



• **Distillation:** copy and label the drawing of the distillation apparatus on p. 47 of your text.

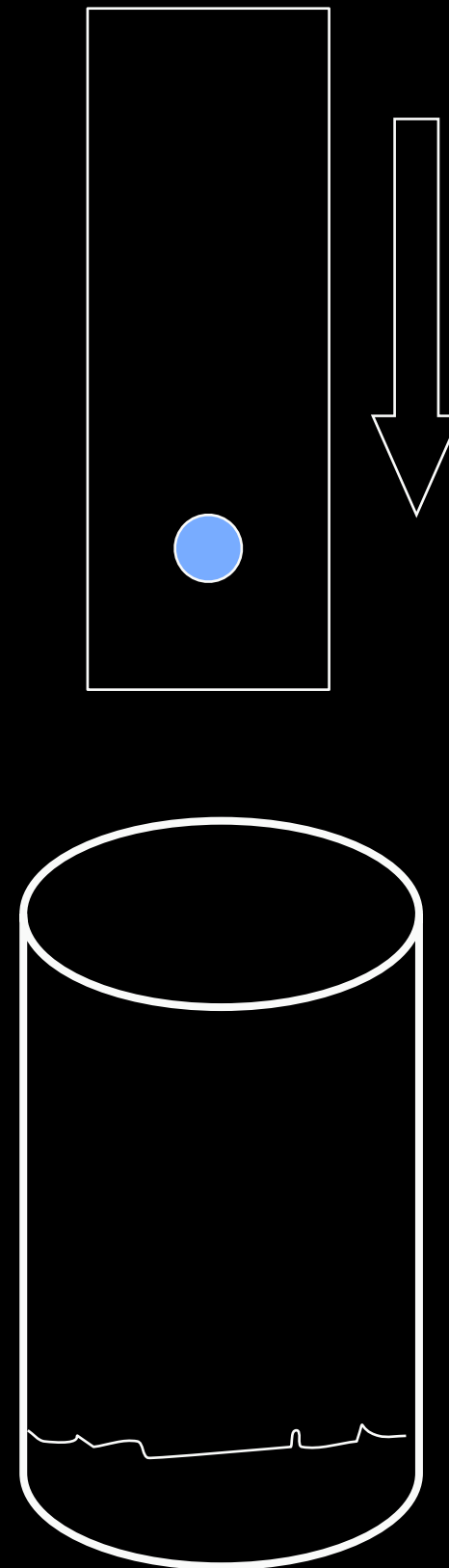
Explain in your notes how it works.

- Separation by temperature
- More specifically BOILING POINTS



Chromatography

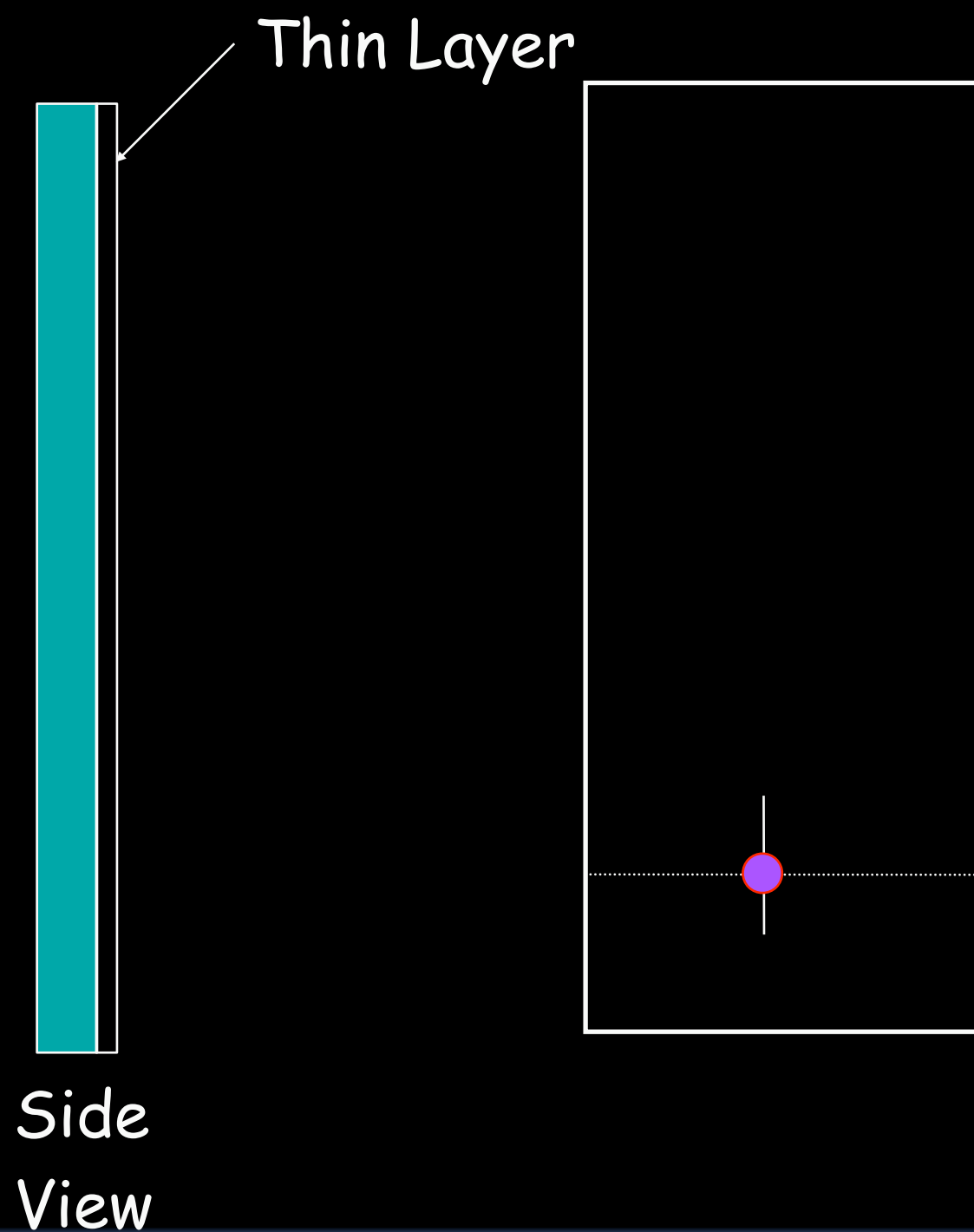
- Obtain Vial of H_2O and paper
- Insert Paper into vial
- Spot should NOT be below liquid level



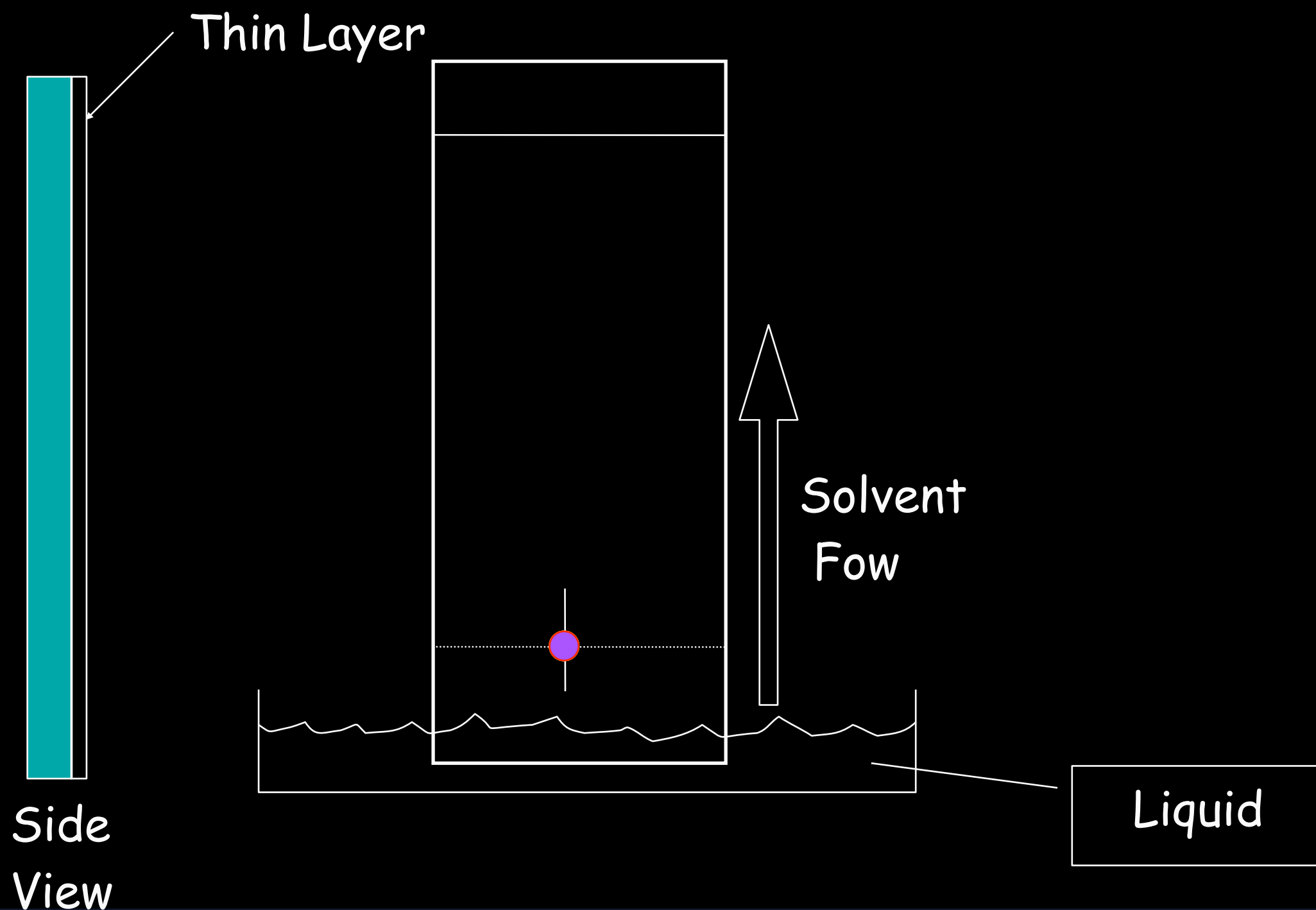
Chromatography

- Purpose
- Essential Components
 - Mixture
 - Stationary Phase
 - Mobile Phase

Thin Layer Chromatography (TLC)



Thin Layer Chromatography (TLC)

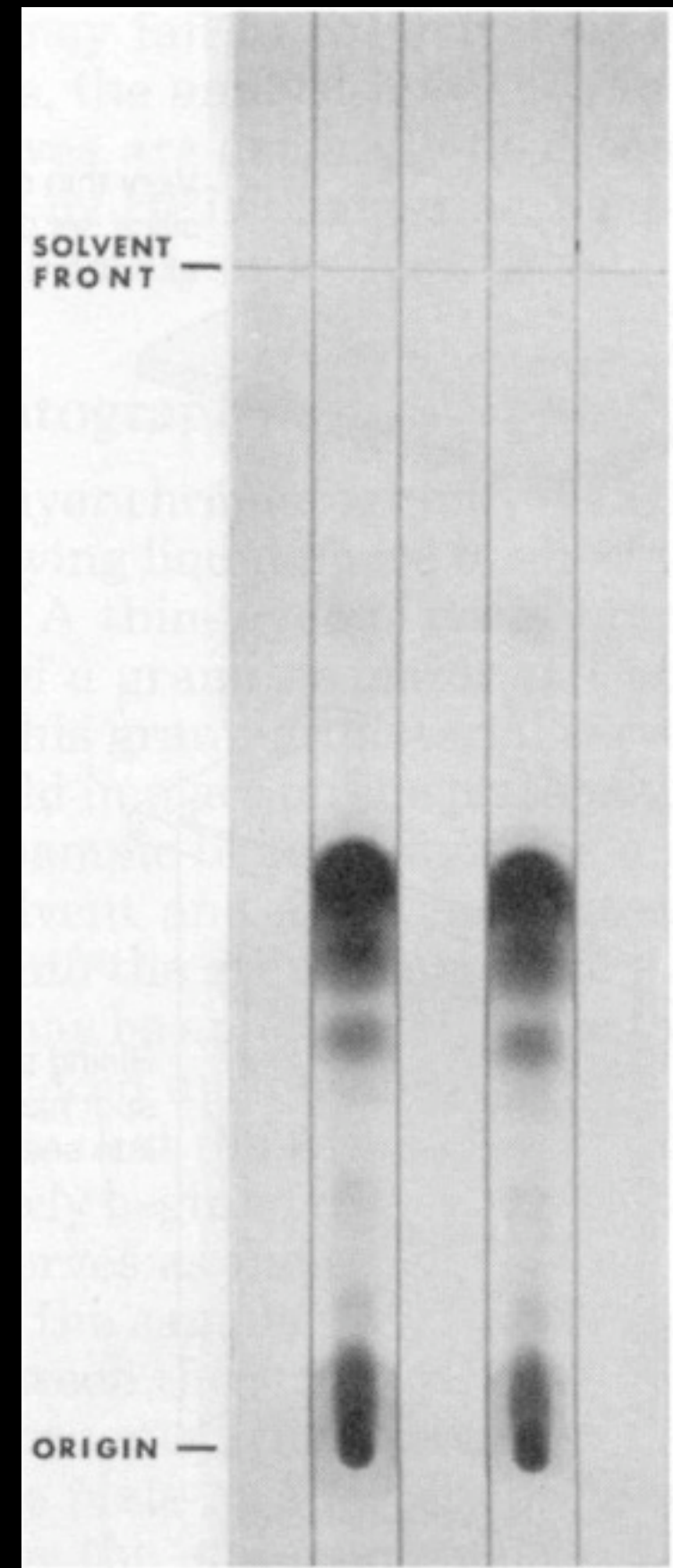


Applications of Thin Layer Chromatography in Forensics

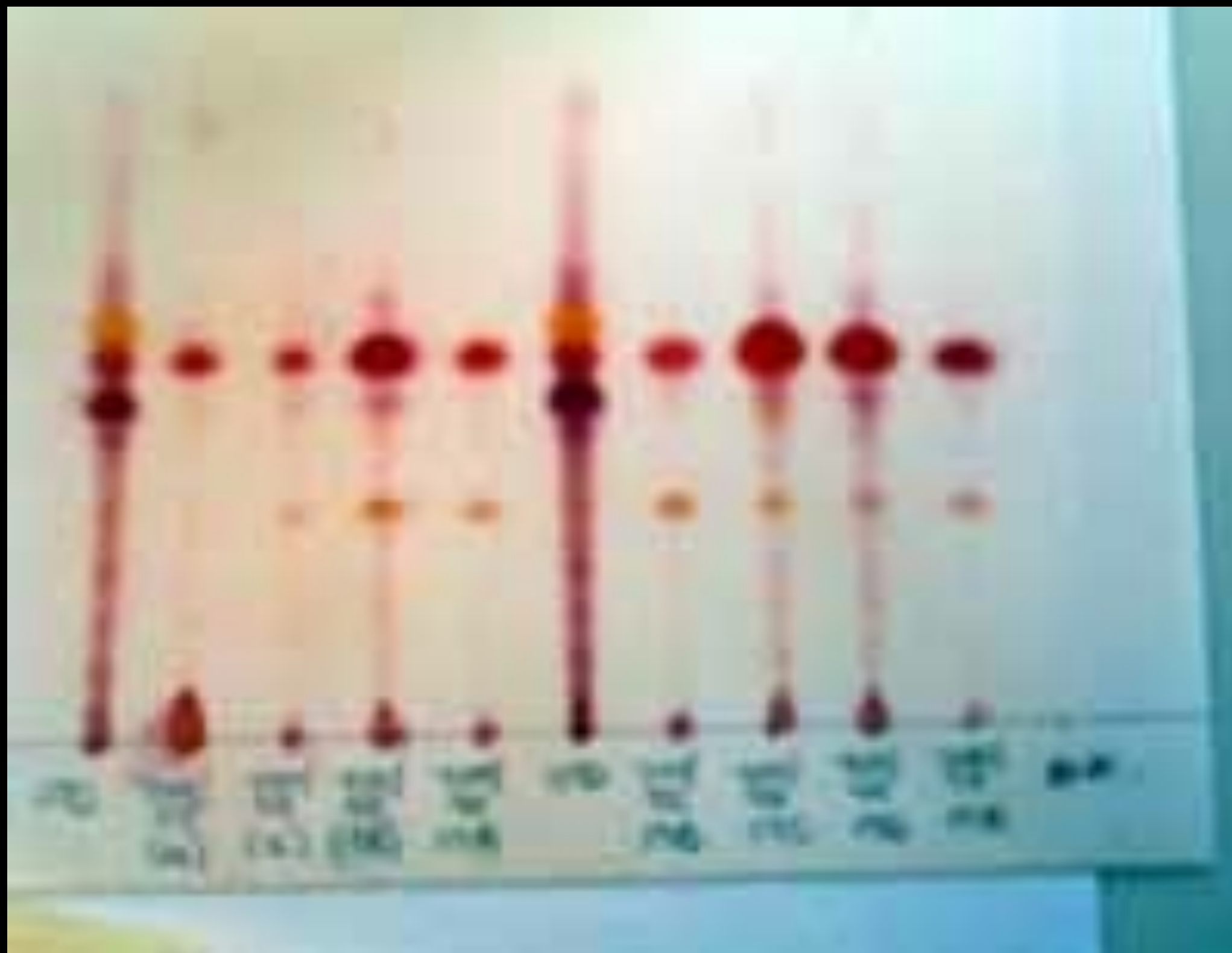
- Inks from Pens
- Drugs
- Dyes (from fibers, etc.)
- Petroleum Products
- Explosives
- Etc.

TLC Marijuana Extract

Each spot represents a component of the mixture



TLC of Marijuana



TLC of heroin sample

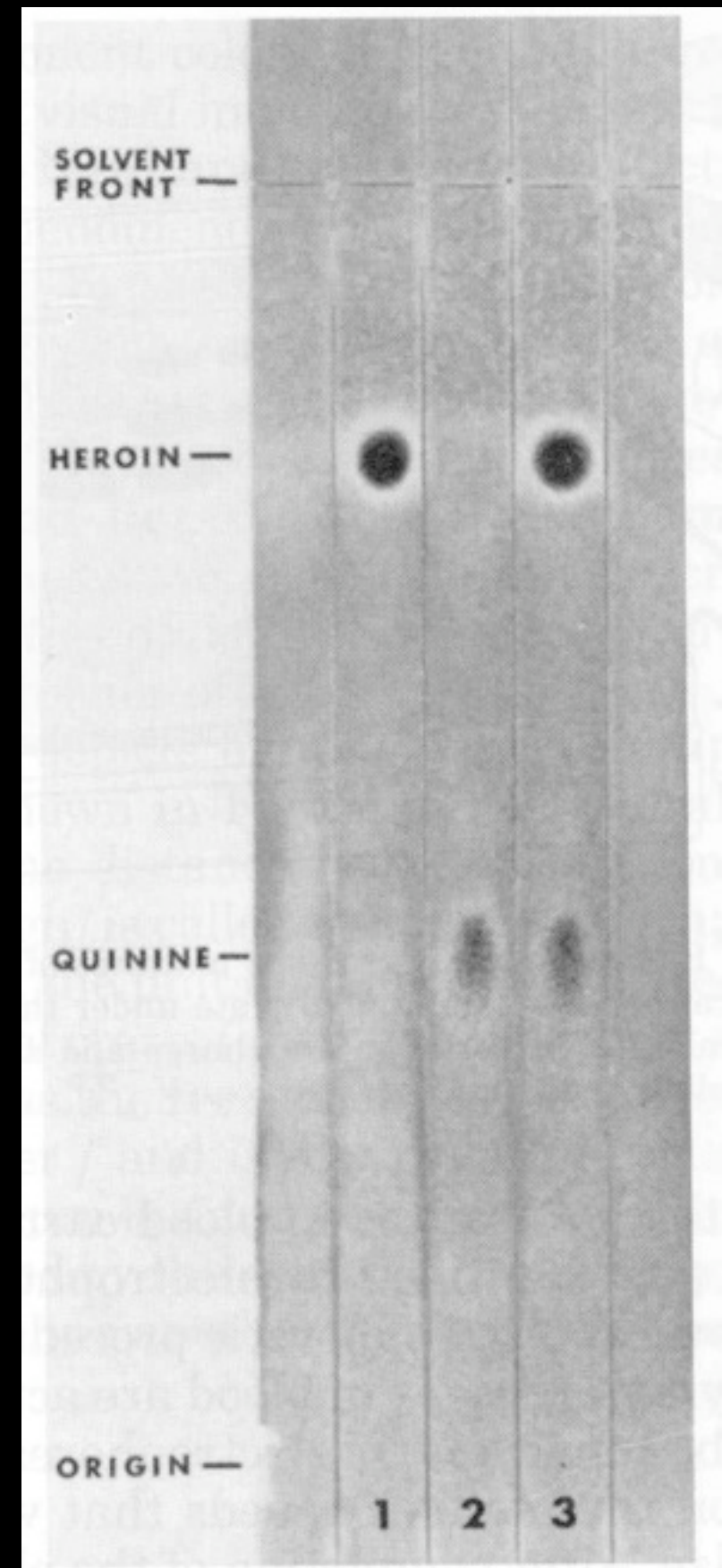
Lanes 1 and 2 are standards

Lane 1 - Heroin

Lane 2 - Quinine

Lane 3 is the sample

$$R_f = \frac{d_{\text{component}}}{d_{\text{solvent}}}$$



Chromatography

- One phase is held in place (sometimes a solid) while another moves past it (often a liquid or a gas).
 - The phases cannot mix with one another
- Encompasses a collection of techniques to separate components of complex mixtures
 - Thin Layer Chromatography (TLC)
 - Liquid Chromatography (LC)
 - Gas Chromatography (GC)

Theory of Chromatography

- Based on differences in the abilities of compounds to "adhere" to a stationary phase while being flushed through it with a mobile phase
 - Stationary phase (does not move)
 - Mobile phase (used to flush sample across SP)
- The reason different molecules separate
 - Intermolecular Interactions
 - Dipole-dipole
 - Dispersion Forces

Properties of Matter

Extensive properties

depend on the
amount of
matter

Intensive properties

depends on the
type of matter



Gold – Extensive properties



Mass = 27 g

Volume = 1.4 ml



Mass = 1000 g

Volume = 51.8 ml

Intensive properties – can be looked up in a reference text.

Phase solid

Density (near r.t.) 19.3 g/ml

Liquid density at m.p. 17.31 g/ml

Melting point 1337.33 K
(1064.18 °C, 1947.52 °F)

Boiling point 3129 K
(2856 °C, 5173 °F)

Heat of fusion 12.55 kJ/mol

Heat of vaporization 324 kJ/mol

Specific heat capacity (25 °C) 25.418 J/mol/K

How do you calculate density?

mass/volume

Sodium chloride (salt) – Extensive properties

mass = 2700 kg
(= 2,700,000 g)

volume = 1,250,000 ml



mass = 6.0 g

volume = 2.8 ml



Intensive Properties

Molecular formula NaCl

Molar mass 58.44277 g/mol

Appearance White or colorless crystals or powder

Density 2.16 g/cm³, solid

Melting point 801 °C

Boiling point 1465 °C (1738 K)

Solubility in water 35.9 g/100 mL (25 °C)

Common physical changes



Evaporation of salt water leaving salt behind



Condensation of water vapor into liquid water (formation of dew)

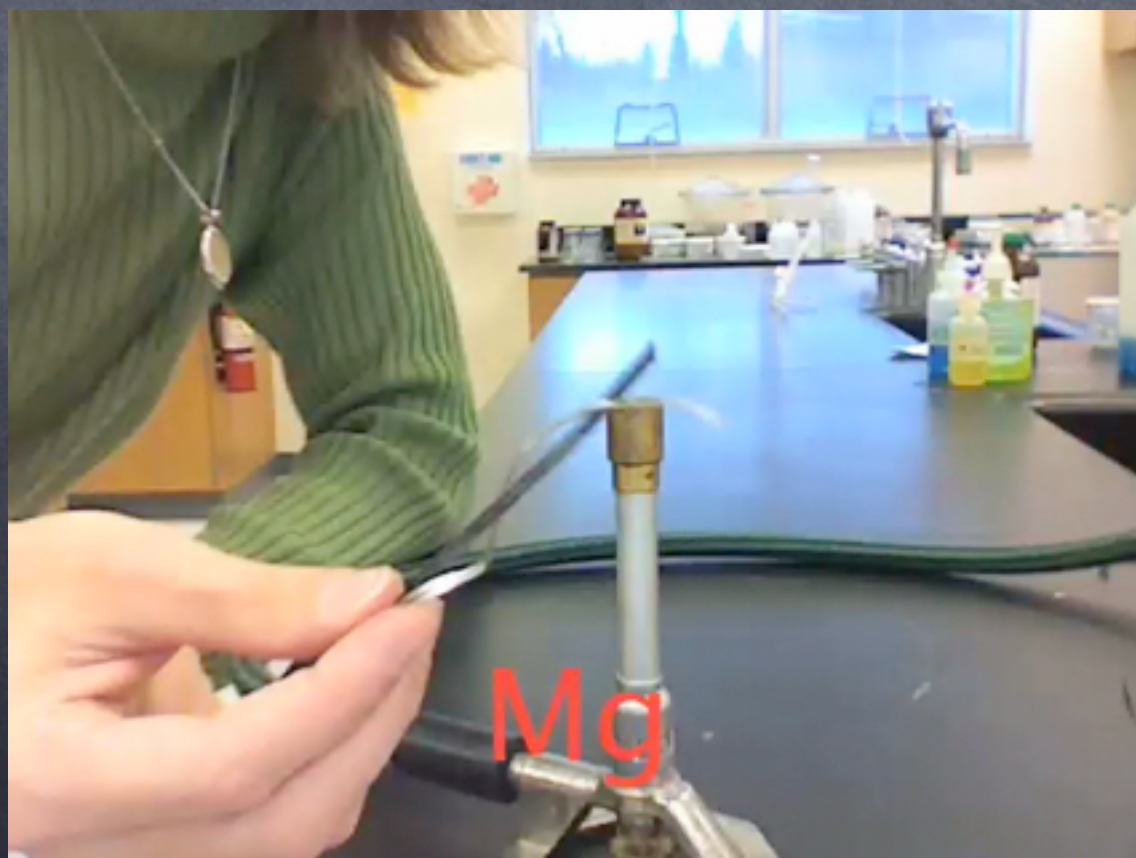
• Hints for detecting CHEMICAL CHANGES

temperature change (heat released or absorbed)

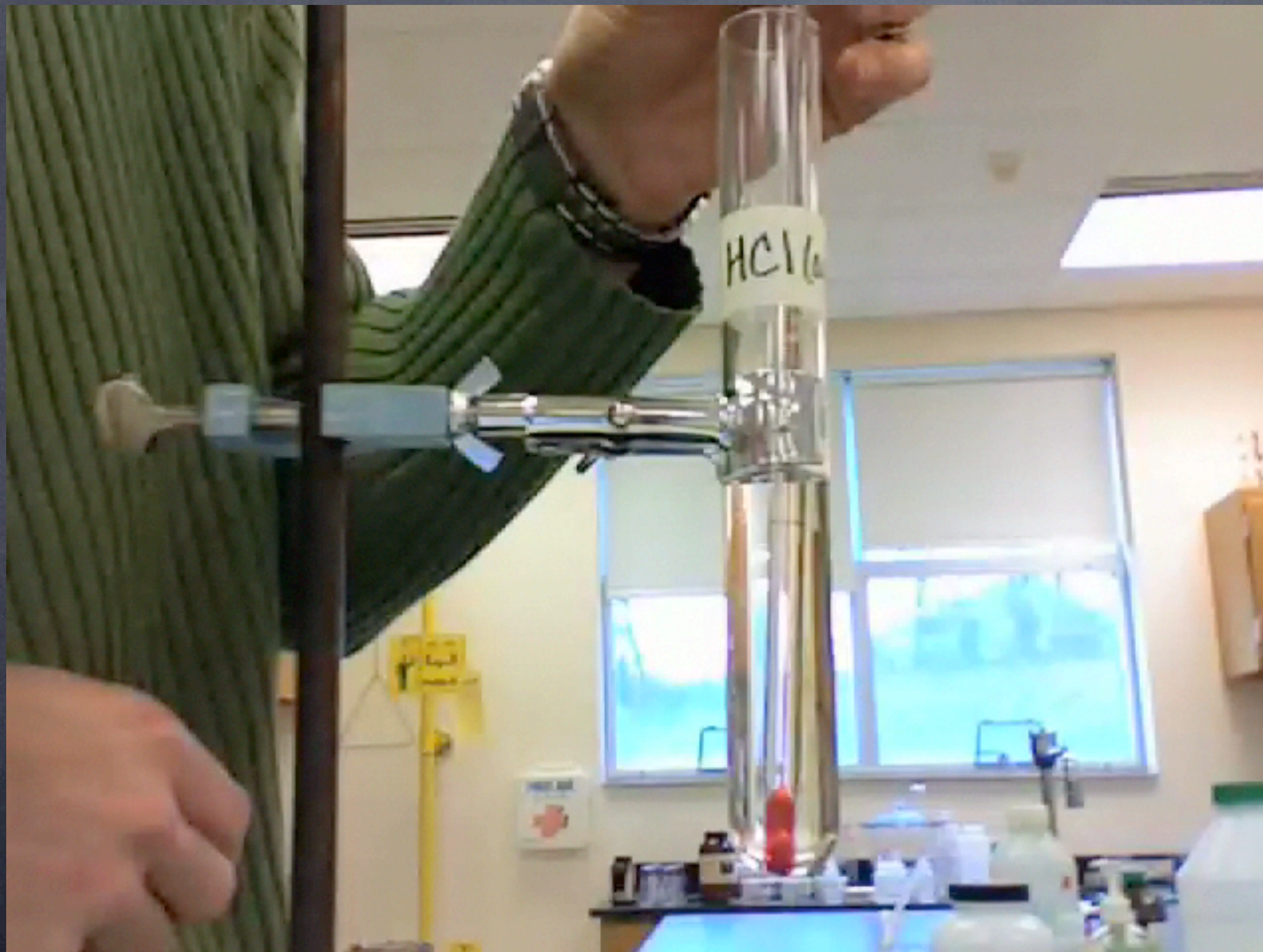
light given off or absorbed



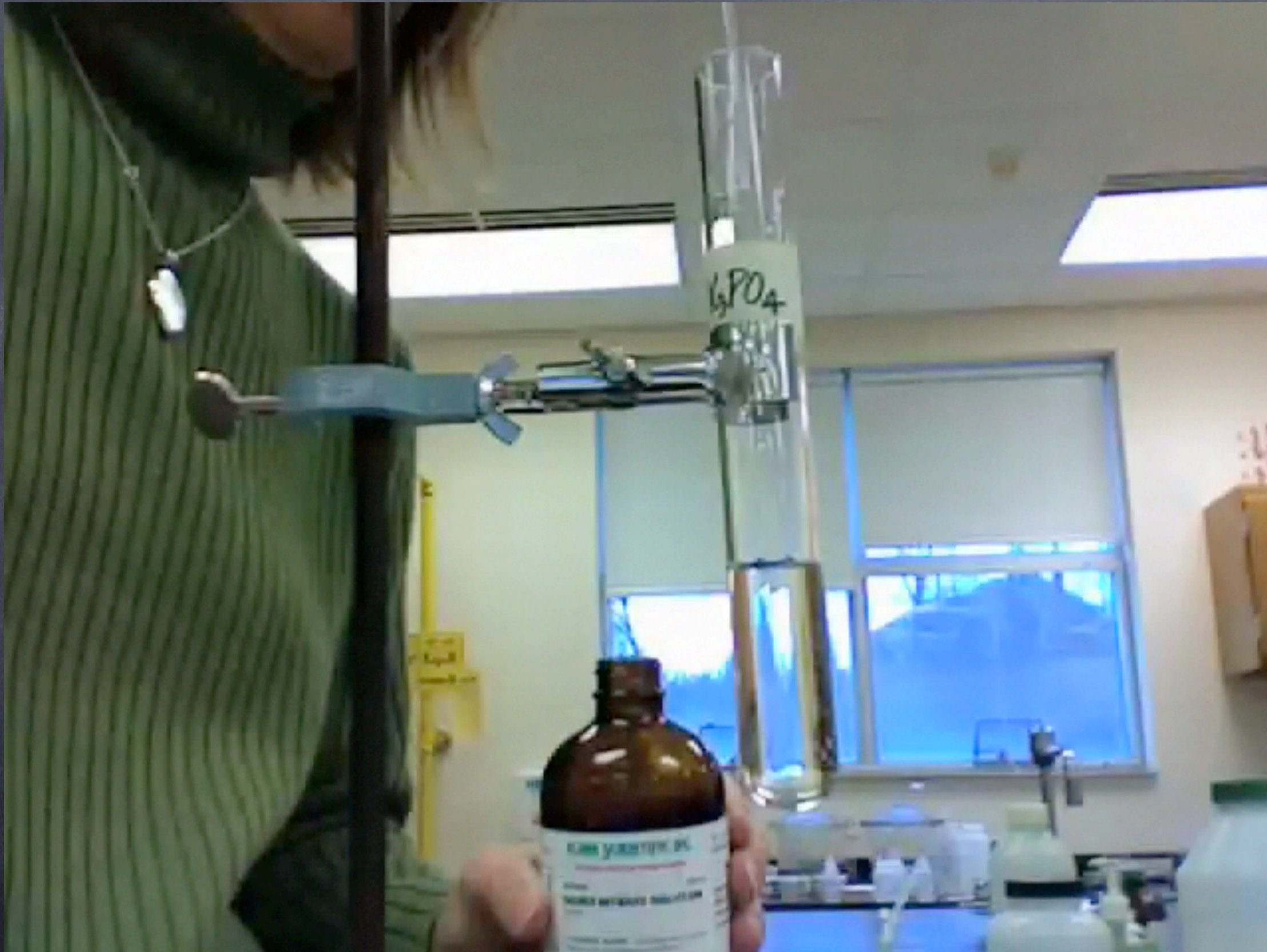
both indicate
a transfer of
energy



bubbles (gas given off)



a solid settling out of a liquid (precipitate)



color change



In chemical reactions THE LAW OF CONSERVATION OF MASS applies.

What is this law?

Mass of reactants = Mass of products



What kinds of chemical reactions may be going on here?